



# Earthquake Seismic Network Its Application in BMKG

**BENNY HENDRAWANTO**

Earthquake Information Sub Division of BMKG

Jln. Angkasa I No. 2, Kemayoran Jakarta 10720 – Indonesia (<http://www.bmkg.go.id>)

*Email* : [benny.hendrawanto@bmkg.go.id](mailto:benny.hendrawanto@bmkg.go.id) ; [mugabe\\_sitorus@yahoo.com](mailto:mugabe_sitorus@yahoo.com)

**THE INTERNATIONAL SYMPOSIUM ON GRIDS AND CLOUDS & OPEN GRID FORUM  
ACADEMIA SINICA TAIPE, TAIWAN  
MARCH 19 – 25, 2011**



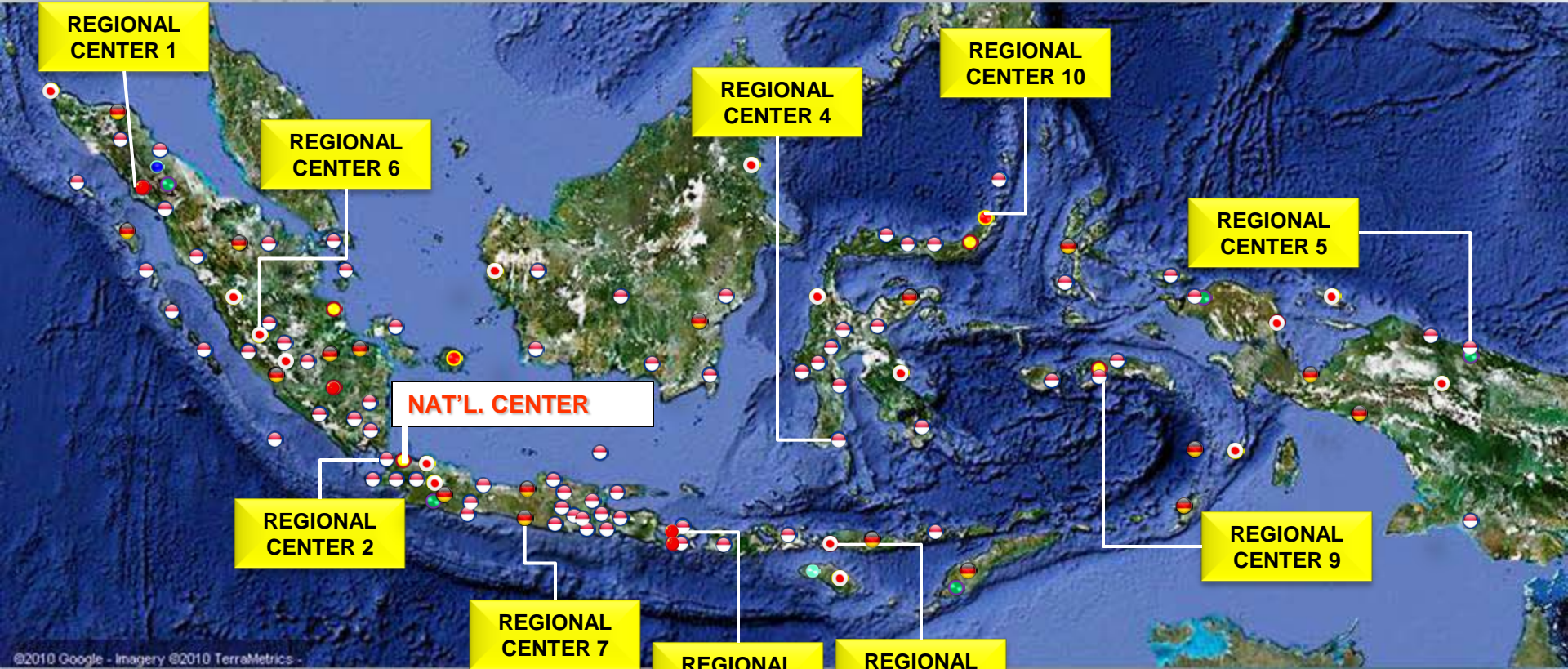
# OUTLINE








- **Indonesia Tsunami Early Warning System**
  - Monitoring system
  - Processing system
- **Test Case Performance of Ina TEWS in Detecting Earthquake and Issuing Tsunami Warning**
- **Future vision and collaboration**



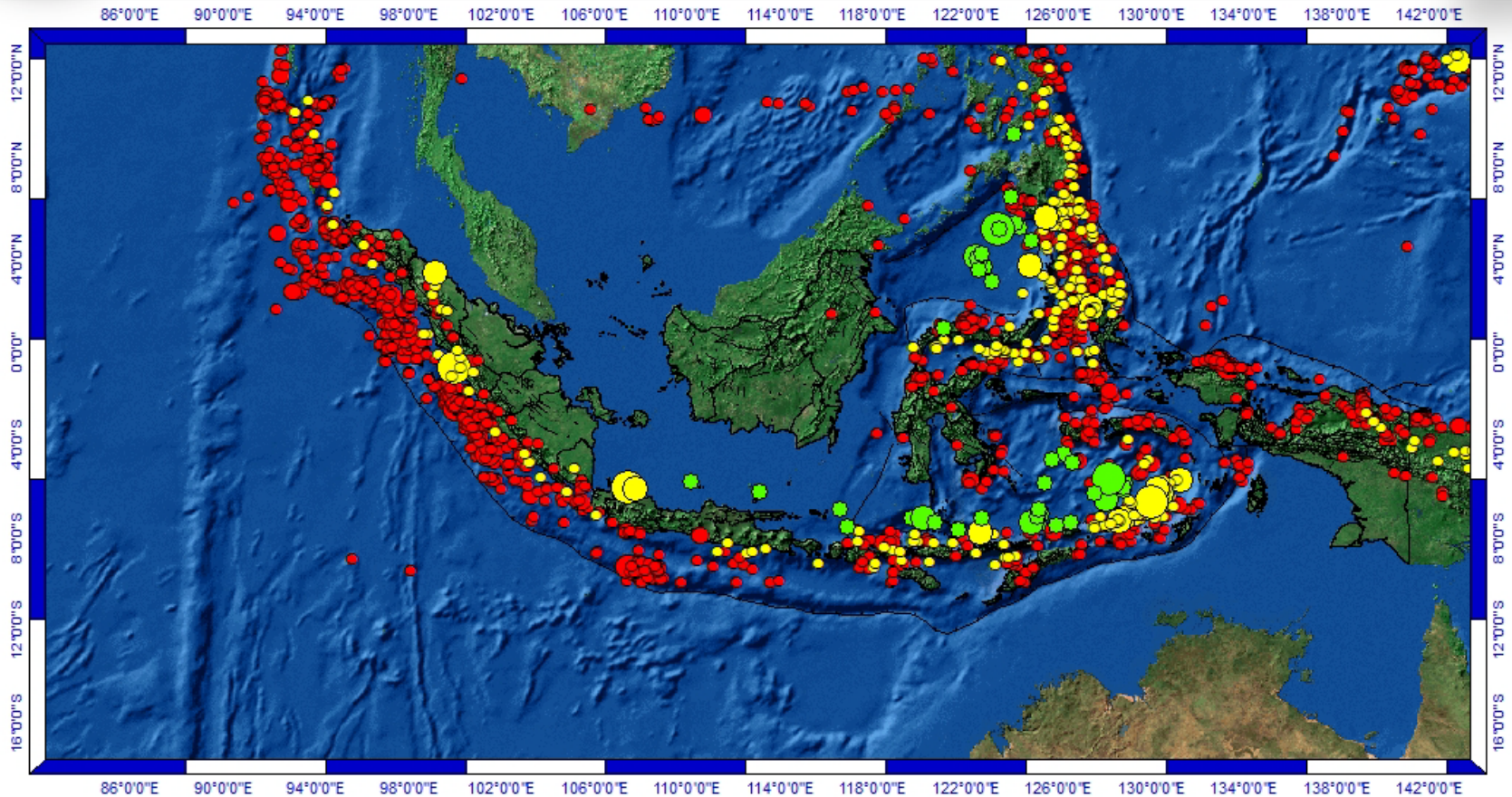
# BROADBAND SEISMIC (158/160) AND ACCELEROMETER (180/500)



©2010 Google - Imagery ©2010 TerraMetrics -

- |   |   |  |
|---|---|--|
|  BMKG (108)  |  JISNET (15) |  ICDSN (10) |
|  GITEWS (22) |  CTBTO (6)   |  |

## MAP OF SEISMICITY , PERIODS 2005 - 2010



0 240 480 960 1,440 1,920 Km

Kedalaman Magnitüde	Dangkal (<100km)	Menengah (100-200km)	Dalam (>200km)
3.0 - 3.7 SR			
3.71 - 4.2 SR			
4.21 - 6.1 SR			



BMKG

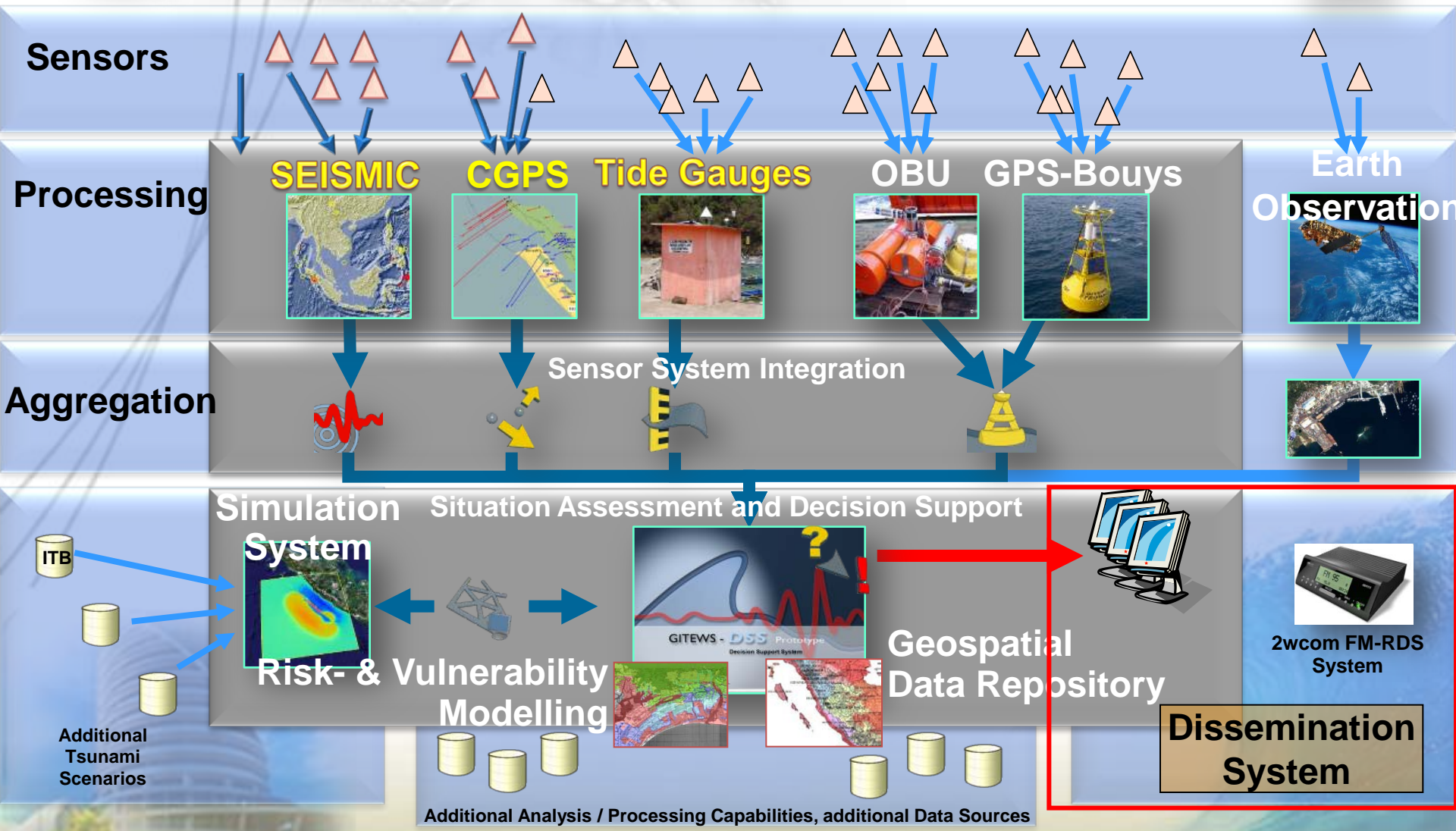
Source :  
Data Source USGS and BMKG



# DECISION SUPPORT SYSTEM



BMKG

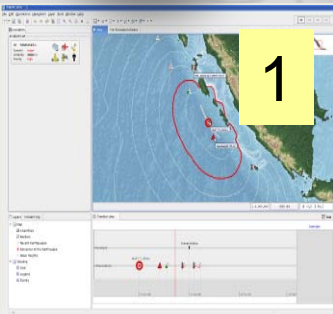




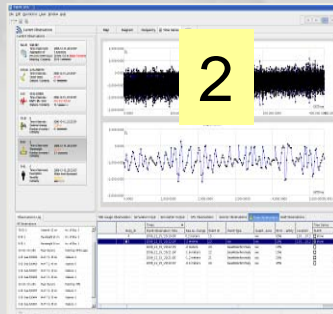
# DSS GUI



BMKG



**Situation**



**Observation**



**Decision**



**Product**

1. Situation;
2. Observation;
3. Decision;
4. Product;

1. First three minute after earthquake occurrence
2. Real time observation of all monitoring system
3. Type of warning prfoposed by the system
4. Message to be sent to a certain region



# DSS GUI



BMKG

File Edit View Window Help

SP OP DP PP

### Situation Awareness

DSS

Seismic

7.7 MwP  
34 KM  
5 stations

6.5 - 7.0 MwP

GTS

7.7 MwP  
34 KM  
all stations

Simulation - 3 scenarios (123, 22, 5)

12:42 ETA  
4m EWH  
90% RMS

Buoys

B1 20 cm

B3 25 cm

B7 0 cm

B4 -00:05:10

Tide Gauges

TG2 -00:12:16

Field Information

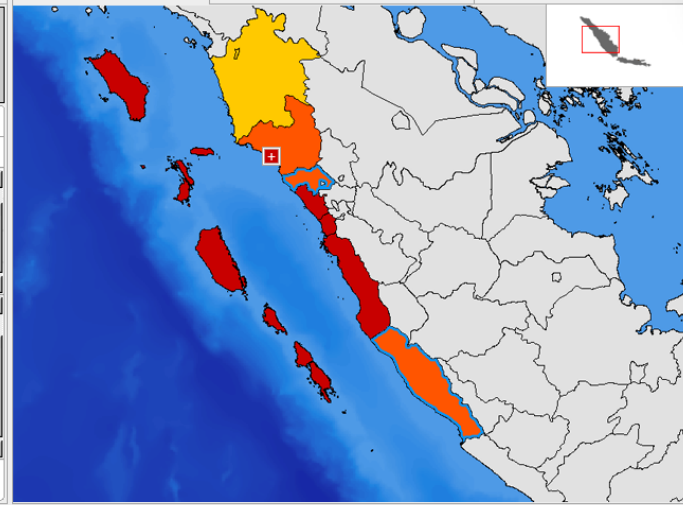
### Decision Status

Monitoring **2006/12/23 12:45:20 UTC**  
**TSUNAMI IN EFFECT 4 Min. 20 Sec. ago**

Time	Action/Task
12:41:00	Alert (SS: 7.4 MwP, 34 km)
12:42:17	Decision Proposal generated
12:42:50	Product disseminated
12:43:23	Decision Proposal adjusted
-04:23	<b>Dissemination</b> Decision Proposal Details Alternatives Risk ..
-02:16	<b>Buoy Activation</b>
	All Clear

### Warning Segment Map

### Warning Segment Map - Coastline



### Warning Product Configuration

Segment	Segment State	Warning Product Proposal	Adjust	Send	ETA
all	all	all	all	all	all
Province 1	Major Warning	Major Warning		<input checked="" type="checkbox"/>	-0:11
Province 2	Warning	Warning		<input checked="" type="checkbox"/>	-0:21
Segment 1	Warning	Warning		<input checked="" type="checkbox"/>	-0:21
Segment 2	Warning	Warning		<input checked="" type="checkbox"/>	-0:21 1.5 m
Segment 3	Warning	Warning		<input checked="" type="checkbox"/>	-0:26 1.2 m
Province 3	Advisory	Advisory		<input checked="" type="checkbox"/>	-0:56 0.4 m
Province 4	Advisory	Advisory		<input checked="" type="checkbox"/>	-1:03 0.3 m
Province 5	No Product	No Product		<input type="checkbox"/>	-

### Buoy Configuration

Buoy	Batt.	Batt. left	ETA	Activ.	Deactiv.	State
B 1		2:25	-0:08	-0:05	-0:45	idle
B 2		2:25	-0:05	-0:02	-0:32	alert
B 3		4:01	-0:52	-0:49	-1:42	idle
B 4		0:45	-0:21	-0:18	-0:34	idle

Major Warning

Warning

Advisory

Cancel or All Clear

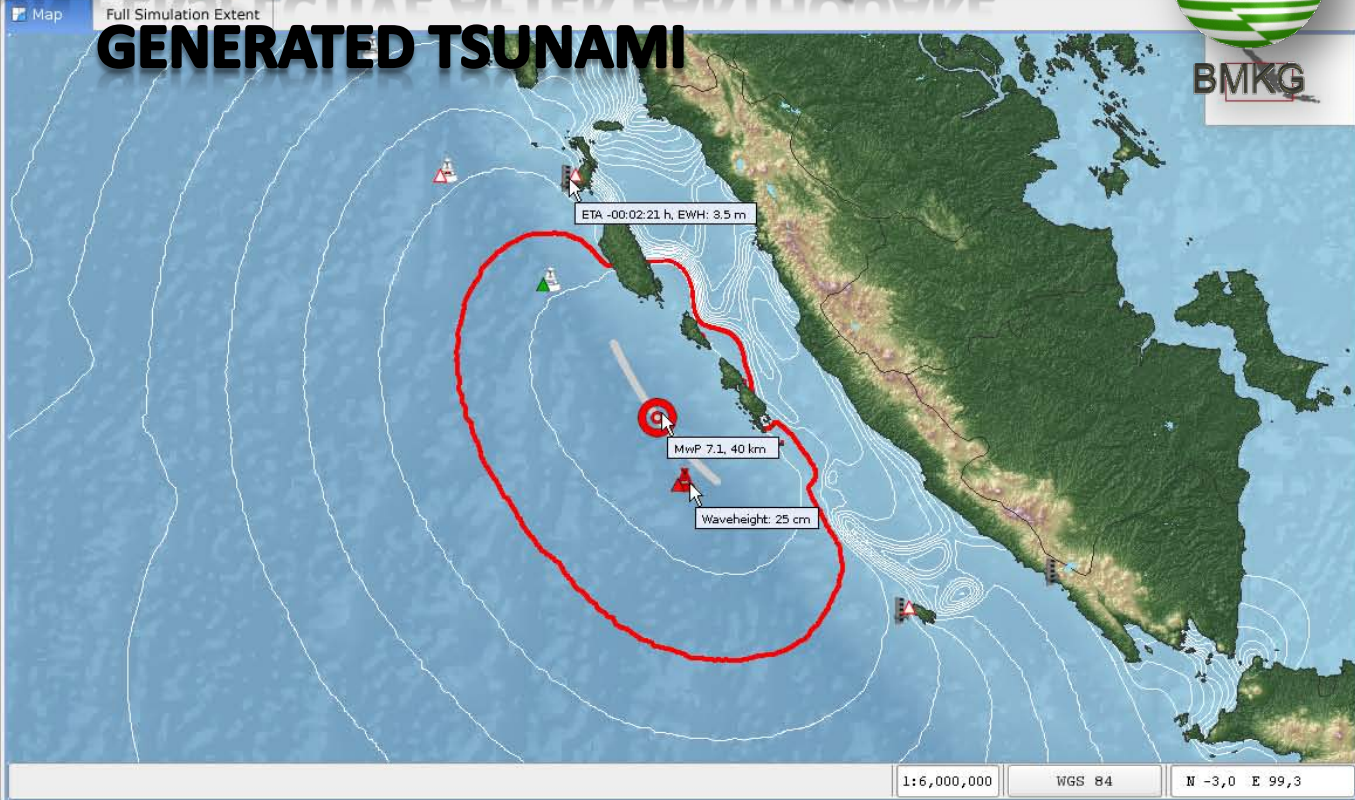
configuration completed



# SITUATION PERSPECTIVE AFTER EARTHQUAKE GENERATED TSUNAMI



ID: T-060515#3-6  
Tsunami: **major**  
Certainty:   
Priority: **high**



- Layers Incident Log
- Map
  - Coastlines
  - Borders
  - Recent Earthquakes
  - Epicenter of the Earthquake
  - Wave Heights
- Timeline
  - Grid
  - Legend
  - Events

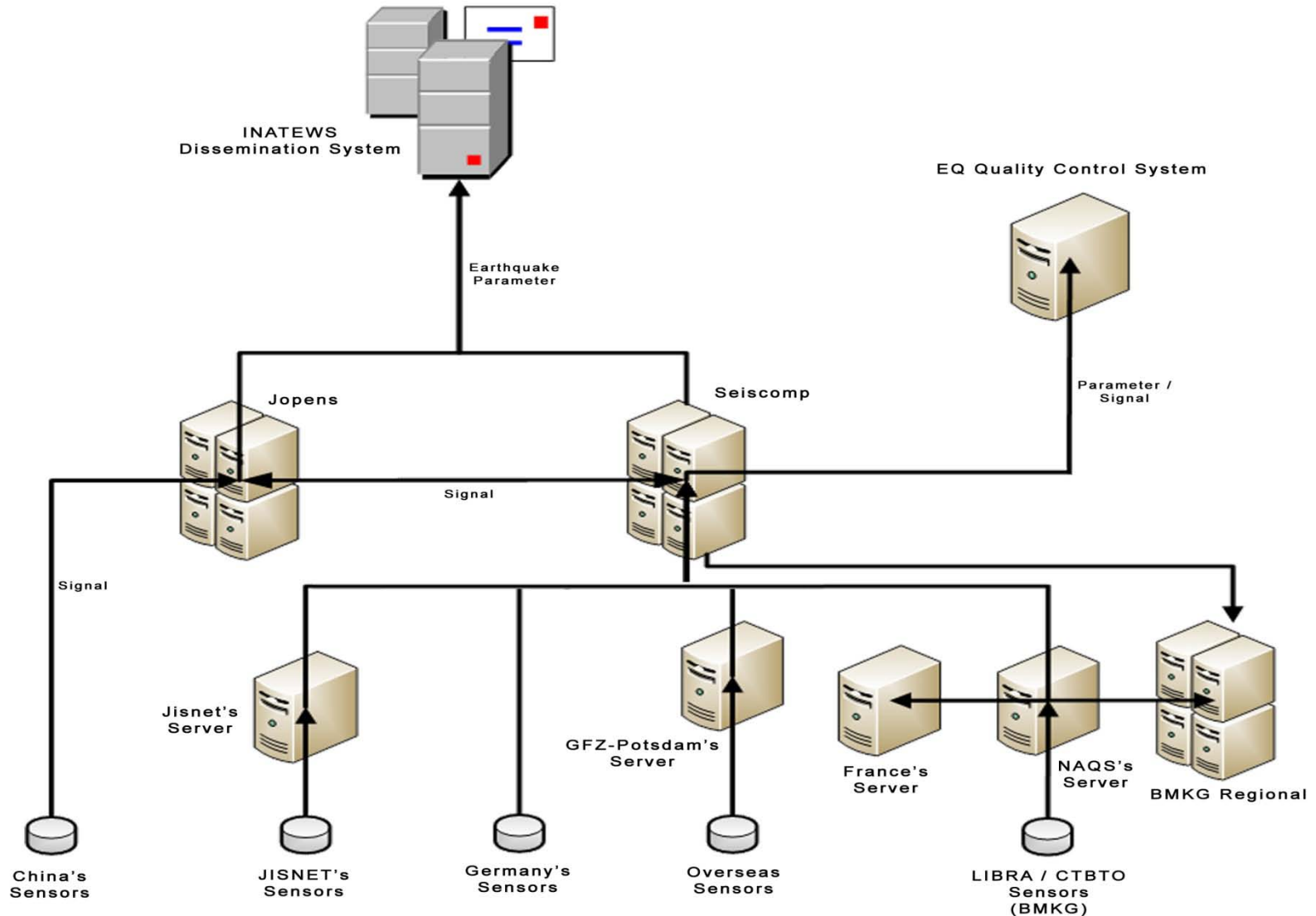






# National Center

# Seismic Processing System



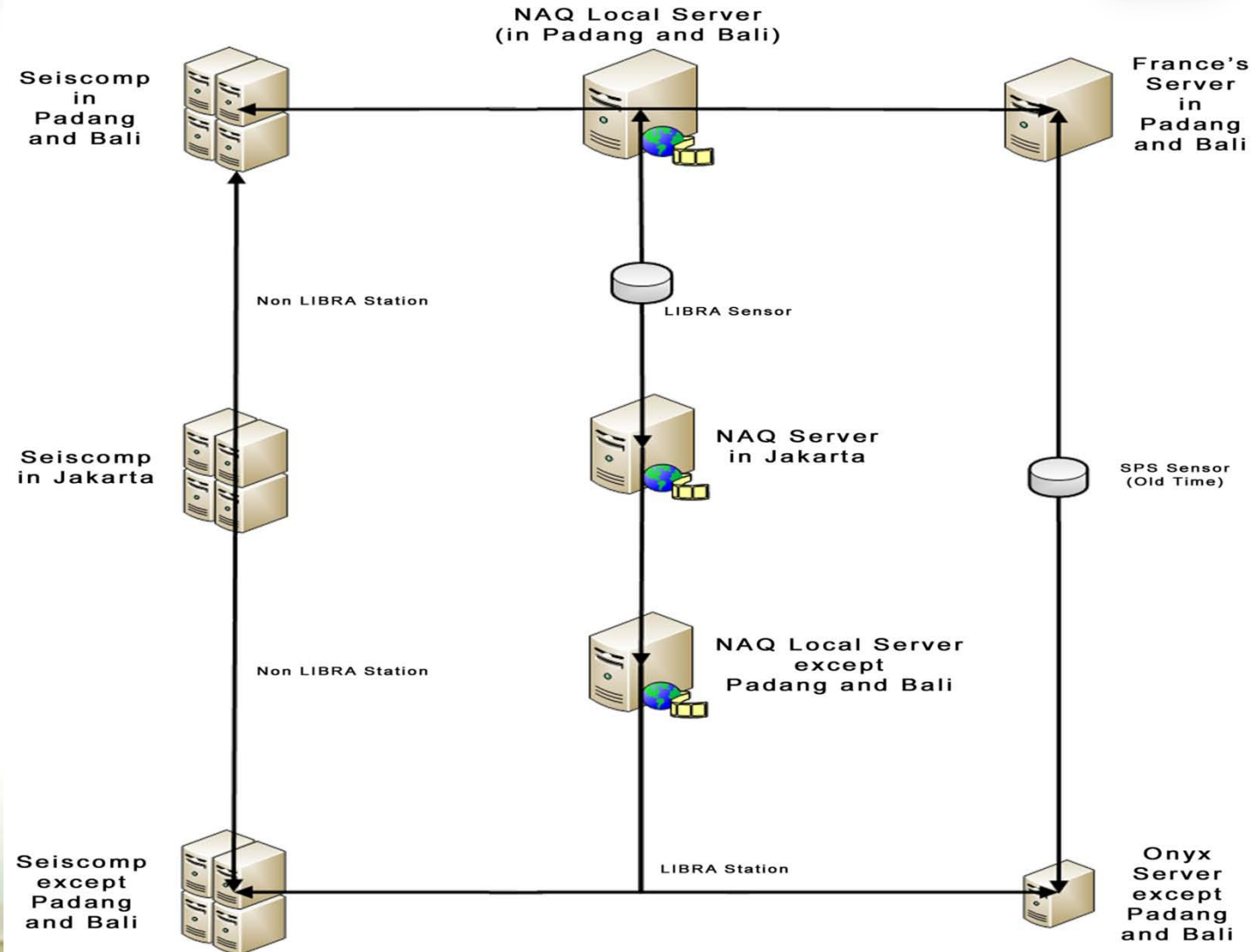


# Regional Center

# Seismic Processing System



BMKG





# OUTLINE



- **INTRODUCTION**
- **Indonesia Tsunami Early Warning System**
  - Monitoring system
  - Processing system
- **Test Case Performance of Ina TEWS in Detecting Earthquake and Issuing Tsunami Warning**
- **Future vision and collaboration**



# WALL DISPLAY



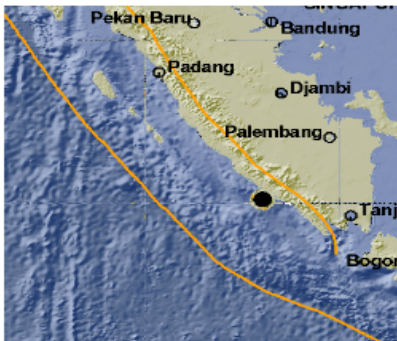
BMKG



## Indonesia Tsunami Early Warning System

Jl. Angkasa I No. 2 Kemayoran, Jakarta 10720 Telp/Fax: 021 6546316 Website: <http://www.bmkg.go.id>

### Info GEMPA dan Peringatan TSUNAMI Terkini



Magnitude:

**7,5**  
Skala Richter

Waktu : 13-Nov-09 02:39:16 WIB

Lokasi : 4.88 LU - 103.02 BT

Kedalaman : 3 Km

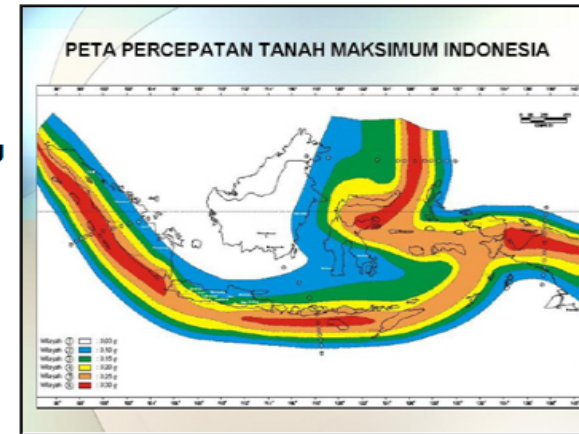
Keterangan lokasi gempabumi :

- \* 41 km BaratDaya BINTUHAN-BENGGULU
- \* 106 km BaratLaut KRUI-LAMPUNG
- \* 121 km BaratLaut LIWA-LAMPUNG
- \* 133 km BaratDaya LAHAT-SUMSEL
- \* 144 km BaratDaya TEBINGTINGGI-BENGGULU

## Berpotensi TSUNAMI untuk diteruskan pada Masyarakat

Waktu isu: 13 November 2009, 16:18:2 WIB

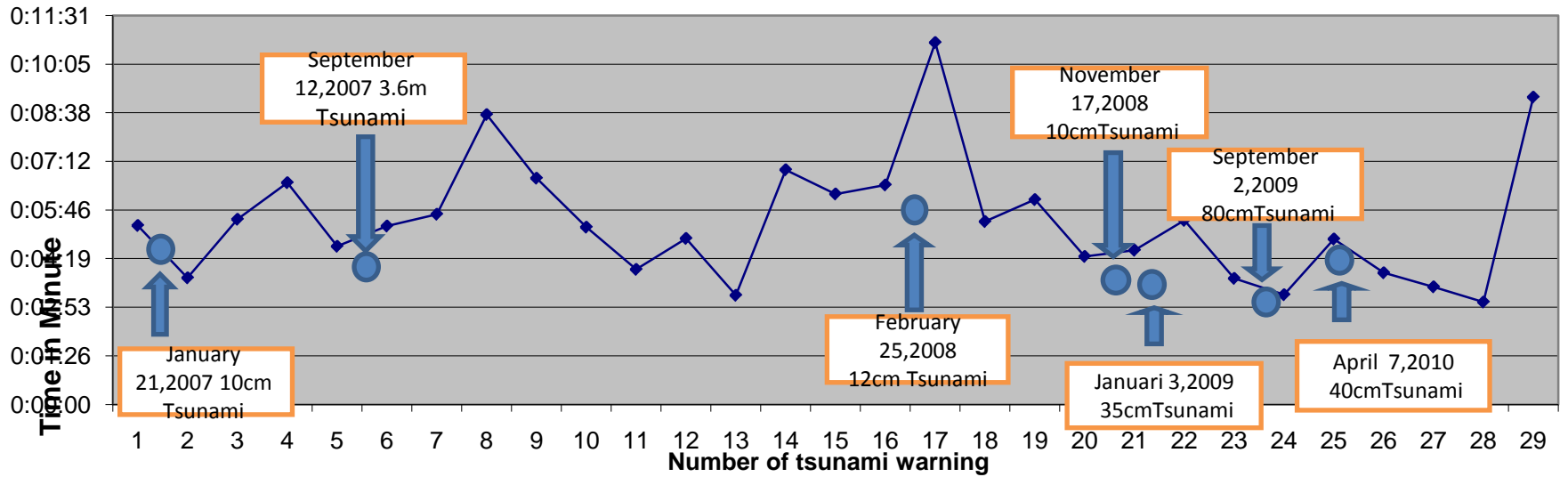
### Tentang INATEWS



PERINGATAN DINI TSUNAMI INDONESIA-INATEWS TELP/FAX: 021 6546316, WEBSITE



### Tsunami warning elapse time





# OUTLINE



- **Indonesia Tsunami Early Warning System**
  - Monitoring system
  - Processing system
- **Test Case Performance of Ina TEWS in Detecting Earthquake and Issuing Tsunami Warning**
- **Future vision and collaboration**



# OUTLINE



- **Indonesia Tsunami Early Warning System**
  - Monitoring system
  - Processing system
  - Dissemination system
- **Test Case Performance of Ina TEWS in Detecting Earthquake and Issuing Tsunami Warning**
- **Future vision and collaboration**

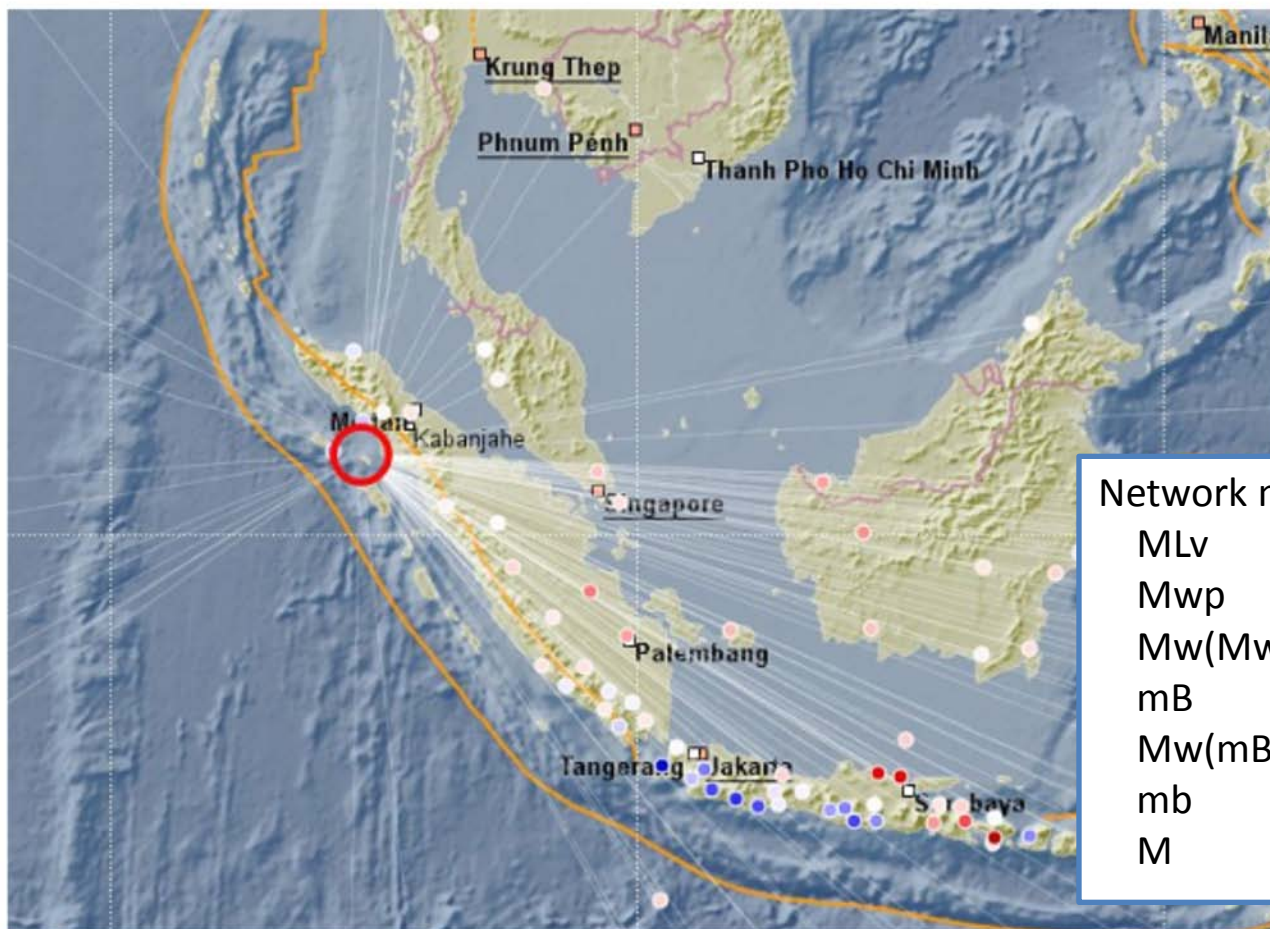


# Earthquake in Sinabang, Aceh 2010



**Date** : Wednesday, 7 April 2010  
**Origin Time** : 05:15:03 WIB,  
**location** : 2.33 N – 97.02 N , Depth **34km**  
**Magnitude** : **7.2 (MLv) (4 min after mainshock), tsunami warning updated to 7.7 (Mwmb), 40 minutes after the mainshock**

BMKG; warning  
PTWC; warning  
JMA; Warning



## Network magnitudes:

MLv	7.17 +/- 0.32	8	preferred
Mwp	7.45 +/- 0.10	6	
Mw(Mwp)	7.85 +/- 0.40	6	
mB	7.66 +/- 0.11	7	
Mw(mB)	7.77 +/- 0.40	7	
mb	6.62 +/- 0.23	7	
M	7.41	8	





# SITUATION PERSPECTIVE 21 MINUTES AFTER THE MAIN SHOCK



DSS

Incidents

2010/04/06 22:17 | 33 | Northern Sumatra, Indone  
Mode: Active  
Threat:   
Certainty:   
Status:

2010/04/06 00:27 | 32 | Timor Region  
Mode: Active  
Threat:   
Certainty:   
Status:

2010/04/05 22:57 | 31 | Near Coast of Southeaste  
Mode: Active  
Threat:   
Certainty:   
Status:

2010/04/05 19:12 | 30 | Banda Sea  
Mode: Active  
Threat:   
Certainty:   
Status:

2010/04/05 14:42 | 29 | Southern Molucca Sea  
Mode: Active  
Threat:   
Certainty:   
Status:

\*Situation Map

2010/04/06 22:38:17 UTC | Incident ID 33

Overview Map  
Pos: 5.1° 107.2°  
UL 13.21° / 82.11° LR -8.71° / 111.71°  
Scale: 1:12,600,000

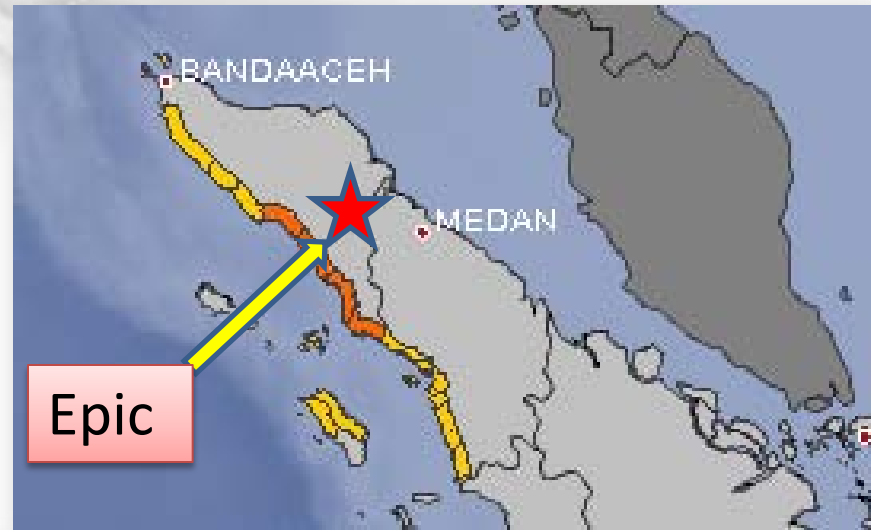
Map/Timeline Selection

Map Layers  
 Tide Gauges  
 CGPS Stations  
 Major Cities  
 Level of risk at warning 1.3.000.000  
 Level of risk at major warning 1.3.000.000  
 Administrative boundaries of Indonesia  
 International borders of Indonesia 1:1  
 Countries World  
 Now Isochrone  
 AWI Simulation Isochrones  
 Bathymetry  
 Bathymetry World

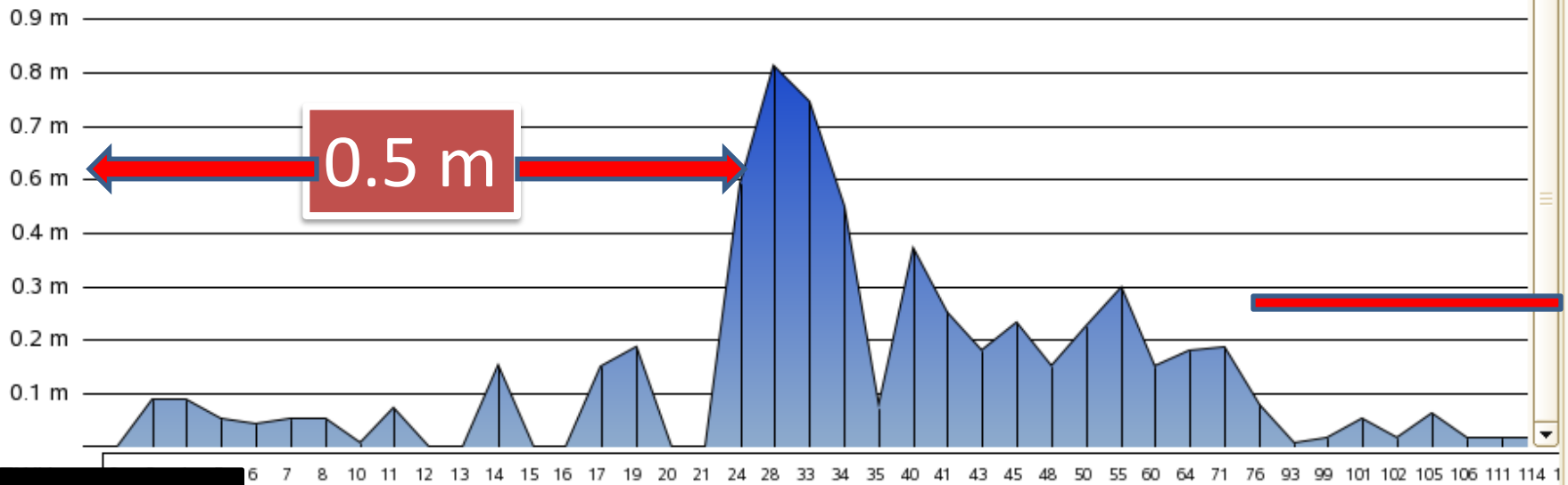
Timeline

Creation Time	Haz	Status	Max S	Moc
2010/04/06 22:17	Tsm	Mediur	Mediur	Actv
2010/04/06 00:27	Tsm	Monit	Monit	Actv
2010/04/05 22:57	Tsm	Monit	Monit	Actv
2010/04/05 19:12	Tsm	Monit	Monit	Actv
2010/04/05 14:42	Tsm	Monit	Monit	Actv
2010/04/05 12:13	Tsm	Monit	Monit	Actv
2010/04/05 11:55	Tsm	Monit	Monit	Actv
2010/04/05 11:31	Tsm	Monit	Monit	Actv
2010/04/05 10:08	Tsm	Monit	Monit	Actv
2010/04/04 23:01	Tsm	Monit	Monit	Inac

# Product of DSS prototype A few minutes after Aceh earthquake, 2010 Before matching process



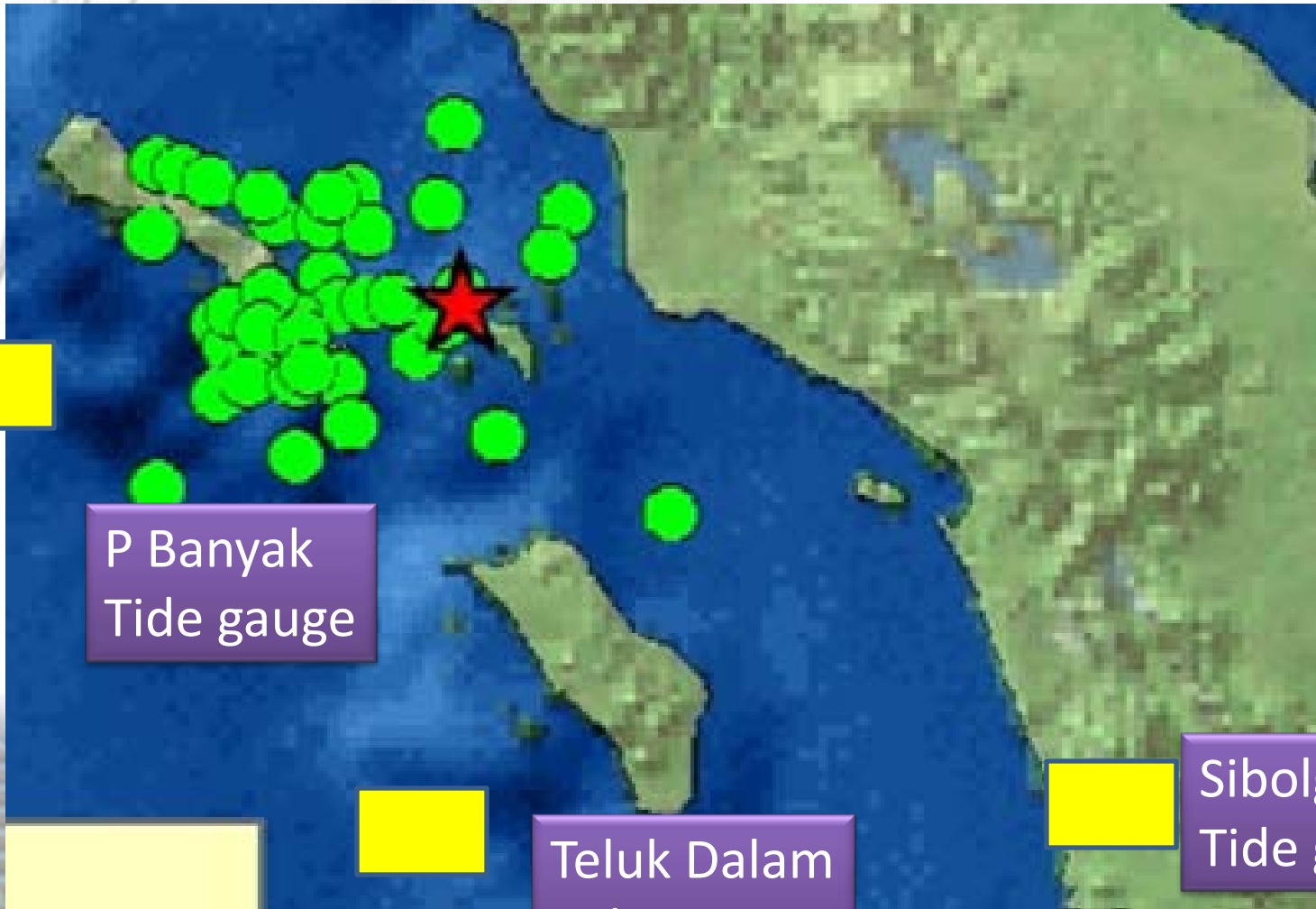
ETH



Segment number



# Main Shock (April 7 2010), aftershock and tide gauge stations



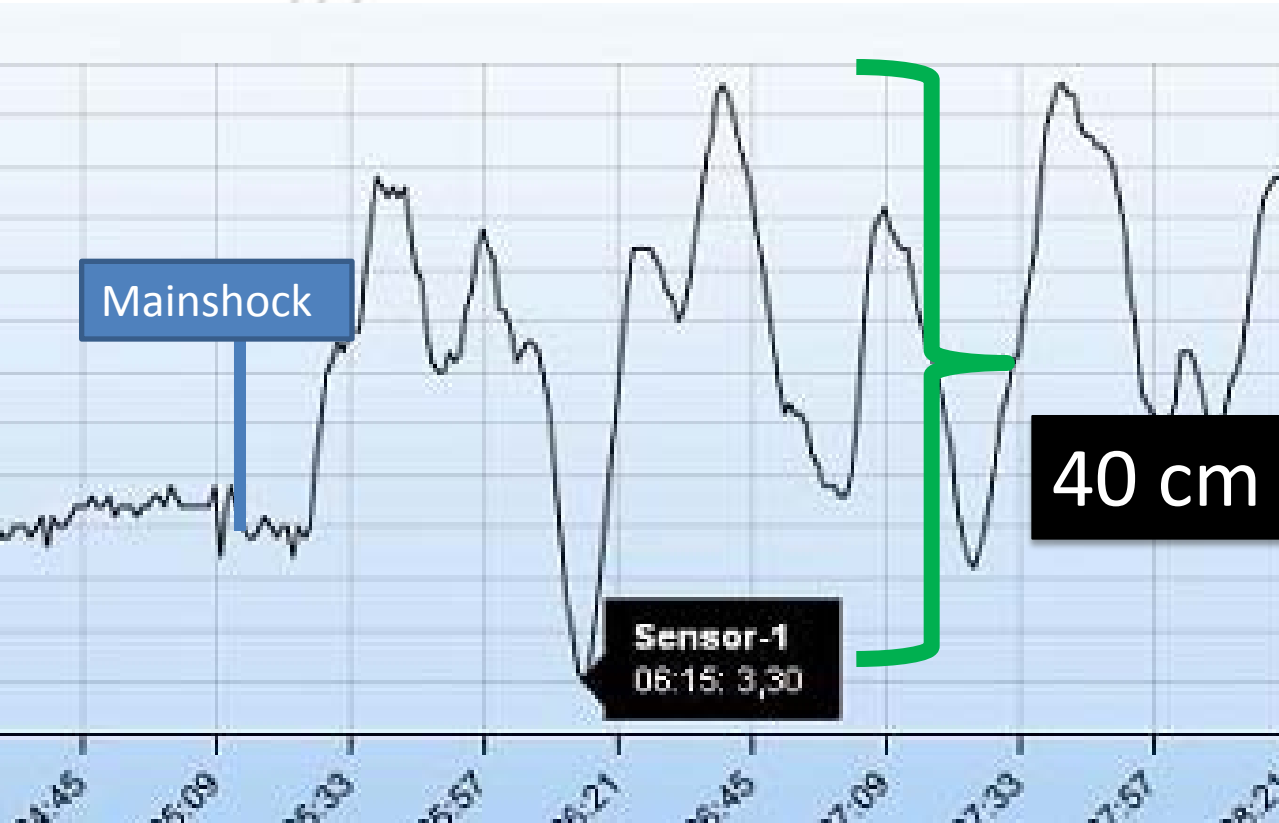
P Banyak  
Tide gauge

Teluk Dalam  
Tide gauge

Sibolga  
Tide gauge



# Tsunami wave record in Pulau Banyak station



Pulau Banyak



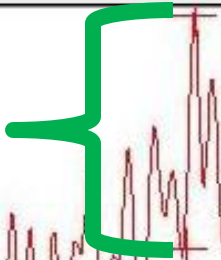


BMKG

REC TIDE DESPIKE PRINT

T(hr:mn)	H(m)
04:52	-0.188
04:42	-0.490
dT(mn:sc)	H(m)
0010:14	0.302

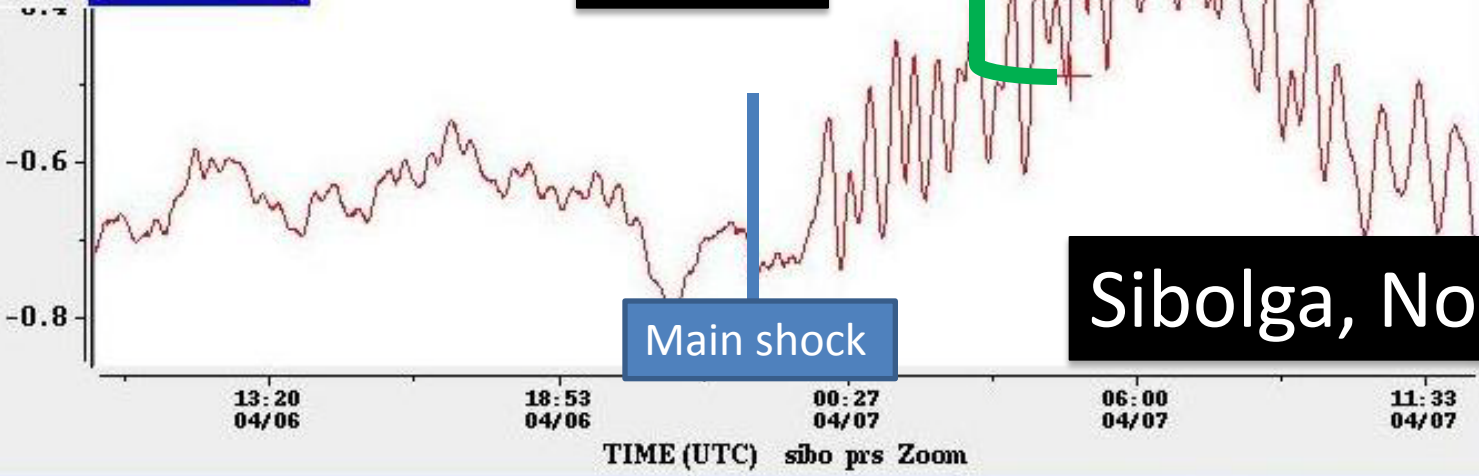
30 cm



Main shock

Sibolga, Nort Sumatra

Meters



T(hr:mn)	H(m)
22:46	5.815

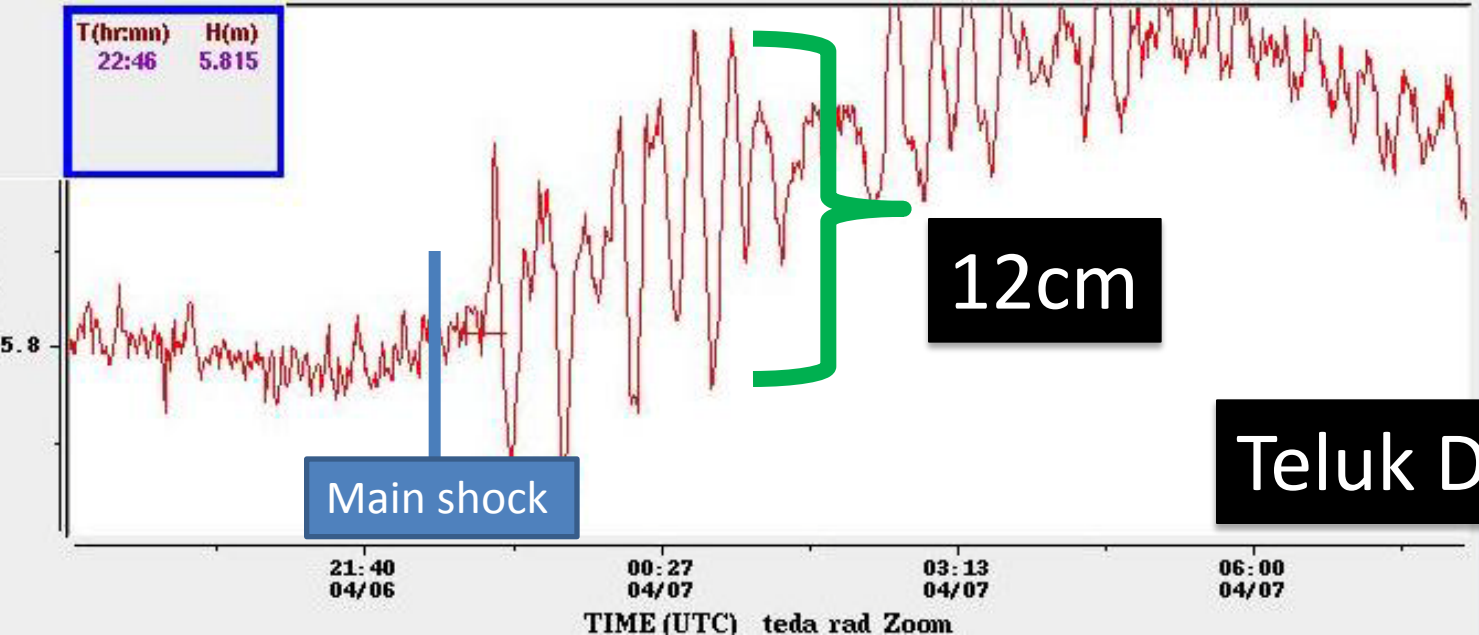
12cm



Main shock

Teluk Dalam, Nias

Meters





# Tsunami height DSS and Indonesian tide gauges



## DSS (Observation)

No	City	Time (UTC)	Tsunami Height
1	Sibolga	22:41:46	0,2 m
2	Pulau Banyak	23:02:45	0,6 m
3	Meulaboh	22:46:17	0,4 m
4	Teluk Dalam	22:38:34	0,2 m

## Indonesian Tide Gauges (Measurement)

No	City	Time (UTC)	Tsunami Height
1	Sibolga	23:49:00	0,49 m
2	Pulau banyak	22:25:00	0,44 m
3	Meulaboh	23:16:00	0,39 m
4	Teluk dalam	22:49:00	0,12 m



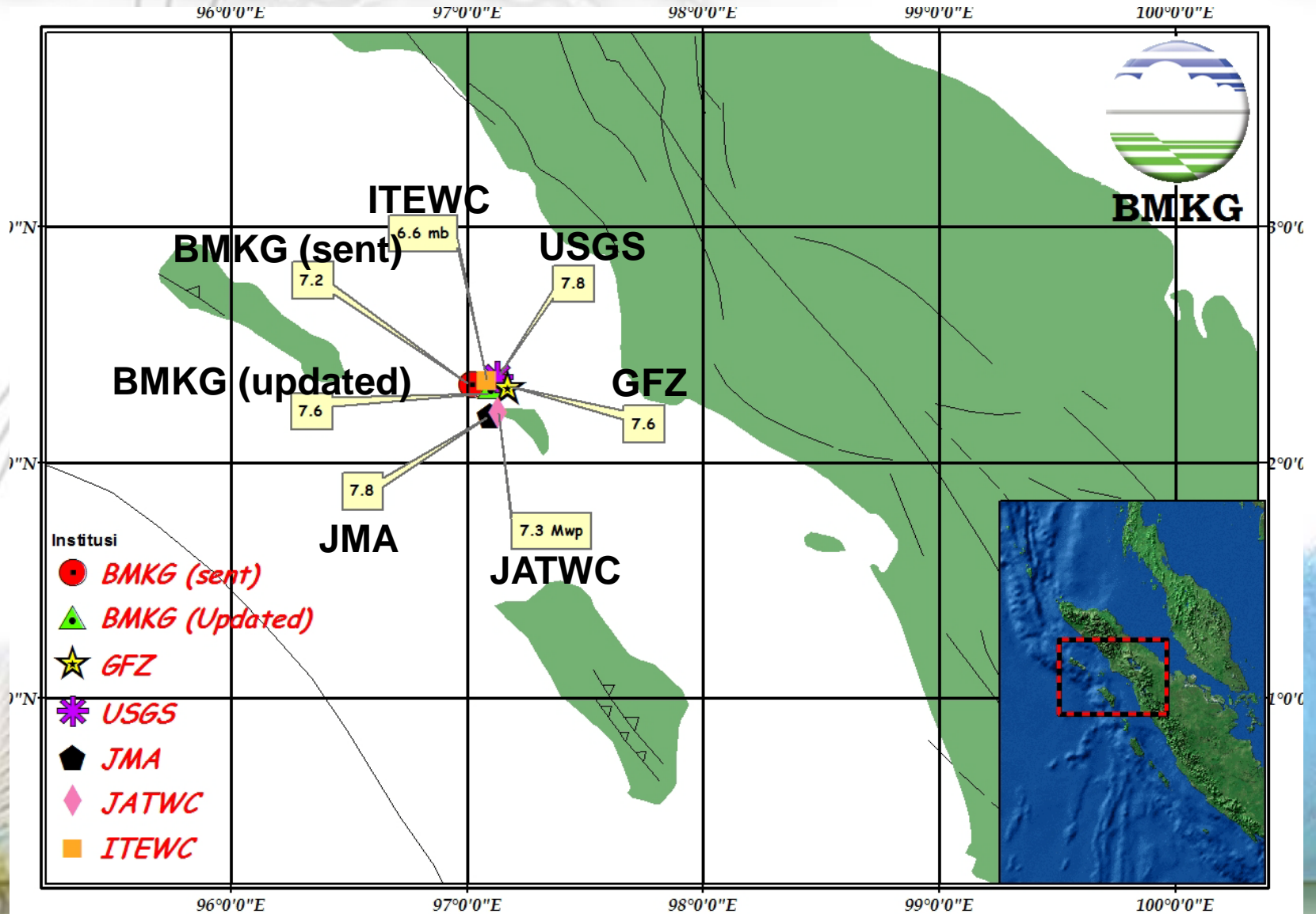
# COMPARASION of SINABANG EARTHQUAKE PARAMETER



No.	INSTITUTION	TIME (UTC)	ELAPSE TIME	LOCATION	DEPTH	MAGNITUDE
1	BMKG (sent)	22:15:03	0:04:51	2.33 <sup>0</sup> N – 97.02 <sup>0</sup> E	34 km	7.2 RS
	BMKG (Updated)	22:15:04	00:11:49	2.32 <sup>0</sup> N – 97.10 <sup>0</sup> E	44 km	7.6 RS
2	U S G S	22:15:02	-	2.36 <sup>0</sup> N – 97.13 <sup>0</sup> E	31 km	7.8 RS
3	G F Z	22:15:13	-	2.32 <sup>0</sup> N – 97.17 <sup>0</sup> E	43 km	7.6 RS
4	JMA	22:15:02	00:08:02	2.02 <sup>0</sup> N – 97.00 <sup>0</sup> E	48.4 km	7.8 RS
5	JATWC	22:14:00	00:09:00	2.21 <sup>0</sup> N – 97.13 <sup>0</sup> E	3 km	7.3 RS
6	ITEWC	22:15:01	00:06:00	2.35 <sup>0</sup> N – 97.08 <sup>0</sup> E	10 km	6.6 RS



# COMPARASION of SINABANG EARTHQUAKE MAGNITUDE







# OUTLINE



- **INTRODUCTION**
- **Indonesia Tsunami Early Warning System**
  - Monitoring system
  - Processing system
  - Dissemination system
- **MITIGATION**
- **Test Case Performance of Ina TEWS in Detecting Earthquake and Issuing Tsunami Warning**
- **Future vision and collaboration**



# Future vision of InaTEWS (1)



## A. Extend the area of interest InaTEWS

1. Internal Indonesian tsunami threat zone
2. South China Sea tsunami threat zone
3. Pacific ocean tsunami threat zone



# Future vision of InaTEWS (2)



C. Inundation and tsunami risk map

E. Capacity building

1. Training for seismology, tsunami,
2. Capacity for the operator
3. Capacity for the engineer
4. Formal education, Master and PhD
5. Lecturers for Academy of Met. Clim and Geo

F. Research collaboration using the InaTEWS data

# InaTEWS

## Indonesian Tsunami Early Warning System



BMKG



BMKG



BAKOSURTANAL



BPPT



MENKOKESRA



LIPI



ESDM



BNPB



BAPPENAS



DEPKOMINFO  
KEMKOMINFO



TNI



DEPDAGRI



DEPLU



DKP



KLH



LAPAN  
LAPAN



ITB



POLRI



GERMANY



CHINA



JAPAN



FRANCE



USA



**THANK YOU  
FOR YOUR ATTENTION**



**BMKG**

**BADAN METEOROLOGI KLIMATOLOGI DAN GEOFISIKA**

JL. ANGKASA I NO. 2 KEMAYORAN JAKARTA PUSAT – INDONESIA

TEL/ FAX. 62 21 4246321/ 4246703

<http://www.bmkg.go.id>